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TOKYO, JAPAN

May 31, 2012

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Jeffrey A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-12137

Subject: **MHI's Amended Response to US-APWR DCD RAI No. 695-4934 Revision 2 (SRP 06.03)**

References: 1) "Request for Additional Information No. 695-4934 Revision 2, SRP Section: 06.03 – Emergency Core Cooling System Application Section: 6.3" dated February 18, 2011 (ML110490580).

2) "MHI's Response to US-APWR DCD RAI No. 695-4934 Revision 2 (SRP Section 06.03)", UAP-HF-11069, dated March 18, 2011 (ML110820196).

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Amended Response to Request for Additional Information No. 695-4934 Revision 2 (SRP 06.03)." This amended response is submitted to update the contents of the response related to the current GSI-191 discussion and closure plan.

Enclosed is the amended response to the RAI contained within Reference 1. The enclosed response completely supersedes the response previously provided in Reference 2.

As indicated in the enclosed materials, this document contains information that MHI considers proprietary, and therefore should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential. A non-proprietary version of the document is also being submitted with the information identified as proprietary redacted and replaced by the designation "[ ]".

This letter includes a copy of the proprietary version (Enclosure 2) of the revised response, a copy of the non-proprietary version (Enclosure 3) of the revised response, and the Affidavit of Yoshiki Ogata (Enclosure 1) which identifies the reasons MHI respectfully requests that all materials designated as "Proprietary" in Enclosure 2 be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

Please contact Mr. Joseph Tapia, General Manager of Licensing Department, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of this submittal. His contact information is provided below.

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NRO

Sincerely,

Y. Ogata

Yoshiki Ogata,
Director- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Enclosures:

1. Affidavit of Yoshiki Ogata

2. Amended Response to Request for Additional Information No. 695-4934 Revision 2 (SRP 06.03) (Proprietary version)

3. Amended Response to Request for Additional Information No. 695-4934 Revision 2 (SRP 06.03) (Non-proprietary version)

CC: J. A. Ciocco
J. Tapia

<u>Contact Information</u>

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Enclosure 1

Docket No. 52-021
MHI Ref: UAP-HF-12137

MITSUBISHI HEAVY INDUSTRIES, LTD.

AFFIDAVIT

I, Yoshiki Ogata, state as follows:

1. I am Director, APWR Promoting Department, of Mitsubishi Heavy Industries, LTD ("MHI"), and have been delegated the function of reviewing MHI's US-APWR documentation to determine whether it contains information that should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential.

2. In accordance with my responsibilities, I have reviewed the enclosed document entitled "Amended Response to Request for Additional Information No. 695-4934 Revision 2 (SRP 06.03)" dated May 31, 2012, and have determined that portions of the document contain proprietary information that should be withheld from public disclosure. Those pages containing proprietary information are identified with the label "Proprietary" on the top of the page and the proprietary information has been bracketed with an open and closed bracket as shown here "[ ]". The first page of the document indicates that all information identified as "Proprietary" should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

3. The information identified as proprietary in the enclosed document has in the past been, and will continue to be, held in confidence by MHI and its disclosure outside the company is limited to regulatory bodies, customers and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and is always subject to suitable measures to protect it from unauthorized use or disclosure.

4. The basis for holding the referenced information confidential is that it describes the unique design information developed by MHI and not used in the exact form by any of MHI's competitors. This information was developed at significant cost to MHI, since it required the performance of Research and Development and detailed design for its software and hardware extending over several years.

5. The referenced information is being furnished to the Nuclear Regulatory Commission ("NRC") in confidence and solely for the purpose of information to the NRC staff.

6. The referenced information is not available in public sources and could not be gathered readily from other publicly available information. Other than through the provisions in paragraph 3 above, MHI knows of no way the information could be lawfully acquired by organizations or individuals outside of MHI.

7. Public disclosure of the referenced information would assist competitors of MHI in their design of new nuclear power plants without incurring the costs or risks associated with the design of the subject systems. Therefore, disclosure of the information contained in the referenced document would have the following negative impacts on the competitive position of MHI in the U.S. nuclear plant market:

A. Loss of competitive advantage due to the costs associated with development of the US-APWR Fluid System Engineering. Providing public access to such information permits competitors to duplicate or mimic the Fluid System Engineering information without incurring the associated costs.

B. Loss of competitive advantage of the US-APWR created by benefits of enhanced US-APWR Fluid System Engineering development costs associated with the pH Control System.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information and belief.

Executed on this 31st day of May, 2012.

Yoshiki Ogata,
Director- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Enclosure 3

UAP-HF-12137
Docket No. 52-021

Amended Response to Request for Additional Information
No. 695-4934 Revision 2 (SRP 06.03)

May 2012
(Non-Proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

5/31/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: **NO. 695-4934 REVISION 2**

SRP SECTION: **06.03 – EMERGENCY CORE COOLING SYSTEM**

APPLICATION SECTION: 6.3

DATE OF RAI ISSUE: **2/18/2011**

QUESTION NO.: 06.03-88

RAI 0.6.03-4-1 (DCD Section 6.3.2.2.5-1)

The pH of the ESF fluids is controlled during a DBA using NaTB baskets as a buffering agent. NaTB baskets are placed in the containment to maintain the desired postaccident pH conditions in the recirculation water. MHI's response to this RAI indicated that "DCD Section 6.3, Figure 6.3-10 shows the containment spray pattern on the floor where the NaTB baskets are installed. One spray pattern indicated in circle, regardless of its size, means that inside the circle is covered by the designed spray flow from one spray nozzle. The maximum spray flow rate that flows into the NaTB basket container was calculated by using conservatively larger number of these spray pattern circles which cover the container. Even if this conservatively estimated spray water flows into the container, the pressure loss in the transfer piping is lower than the difference of elevation between the container and RWSP, that is, the driving force to gravity injection. Therefore, the NaTB solution in the container does not overflow from the container to the outside of RWSP."

In response to RAI 6.3.2.2.5-1, MHI stated that if the driving head of the flow is greater than the corresponding pressure drop in the piping leading to the RWSP, then the basket will not overflow. The related questions are:

a. As stated in DCD Section 6.3.2.2.5 in the fourth paragraph that "The upper lips of the NaTB Basket Containers are approximately 1 ft. - 7 in. above the top of the NaTB baskets. This allows for the full immersion of the baskets and the optimum NaTB transfer to the RWSP." This indicates that the water level surrounding the NaTB must be maintained above the NaTB but below the top of the NaTB basket container. DCD Figure 6.3-12 appears to indicate that the fluid flow from the container is transferred through 6" piping that is submerged in the holding basket container and the pipe goes up from the lower part of the holding basket container to some point above the NaTB basket and through the basket container wall and down to the RWSP.

   1) Please provide a detailed description including elevations of this flow path and where it combines with the flow path from the other basket container (See DCD Figure 6.3-12). Provide a comparison of driving head and piping pressure loss and any relevant assumptions.

2) Since the piping inlet for fluid removal from the basket container appears close to the bottom of the basket container, justify that debris cannot accumulate in the lower part of the basket container and block the flow to the RWSP.

b. Under maximum flow conditions for the containment spray ring D can the flow into the NaTB basket container be great enough to overflow the container and spill into the containment deck? If so, discuss the potential for the flow to be diverted to a hold-up area and discuss the impact on RWSP pH.

c. What are the conservative flows into the NaTB container and what is the expected pressure drop through the piping to the RWSP? Provide the pressure drop and head comparison.

d. In Figure 6.3-12 Note 2 states "Raise the outlet piping to a level 4'-3" higher than the bottom of the NaTB basket container and layout piping with a down slope from the outlet piping to RWSP." Figure 6.3-11 indicates that the height of the NaTB basket is 4'-11". How do you know that you are getting enough water coverage on the NaTB baskets to satisfy the design basis of maintaining the correct pH of the RWSP? Provide a calculation or discussion that supports the claim that the NaTB baskets would be fully immersed during minimum flow conditions for the containment spray ring D.

ANSWER:

a.1) RAI Figure 6.3.88-1 shows the flow paths from the NaTB basket containers A, B, and C to the RWSP with elevations. RAI Figure 6.3.88-1 also shows the flow rate of each path that is used to evaluate piping pressure loss. Please refer to the response to Item (c) below for the comparison of driving head and piping pressure loss, and the relevant assumptions.

a.2) The piping inlets are provided between the NaTB baskets in the container as shown in RAI Figure 6.3.88-2. There are no obstacles above the piping inlet at the bottom of container. Therefore, debris flows into the pipe inlet with the NaTB solution and is discharged into the RWSP without blocking the connection to the transfer pipe.

b. Spray water will not overflow from the NaTB basket container under the maximum flow conditions for the containment spray ring D. Please refer to the answer to Item (c) below for a quantitative evaluation.

c. Head loss of flow paths under the maximum spray flow conditions are evaluated as follows:

<u>Calculation conditions</u>

i) Flow rate into the container

Flow rate into each NaTB basket container is estimated based on the spray pattern shown in Figure 6.3-10 of DCD Ch. 6.3. The following assumptions are made to estimate a conservative maximum spray water flow rate:

- All spray water from one spray nozzle flows into the container, even though only partial flow from the spray nozzle of the spray ring C covers the container,

- Four CS/RHR pumps are in operation,

Spray water flowing into each NaTB basket container based on the conditions described above are shown in Table 6.3.88-1.

ii) Piping pressure loss

Piping pressure loss is calculated using Darcy's equation (Ref. 6.3.88-1):

$$h_{lineloss} = \sum f \cdot L/D \cdot \frac{v^2}{2g} + \sum K \cdot \frac{v^2}{2g} \qquad \text{(Equation 6.3.88-1)}$$

Where:

$h_{lineloss}$	:	Piping head loss (m)
f	:	Friction factor (-)
L/D	:	Equivalent length of a resistance to flow, in pipe diameters (-)
v	:	Flow velocity (m/s)
K	:	Resistance coefficient (-)
g	:	Gravity acceleration (m/s^2)

Flow rate and piping pressure loss of each flow path is shown in RAI Table 6.3.88-2. The flow rate of each path is the same as that in RAI Figure 6.3.88-1.

iii) Driving head

The gravitational driving head from the A, B, and C-container to the RWSP is [ ], which is the static head differential between the elevation of the free surface in the container and the elevation of transfer pipe outlet end, [ ]. The elevation of the free surface is the elevation of the horizontal region of the inverse U-pipe attached to the container outlet header, [ ].

iv) Comparison of head loss and driving head

RAI Table 6.3.88-3 shows the comparison of the head loss of transfer pipe from the A, B, and C-container to the RWSP and the gravitational driving head.

Head loss of the transfer line from each container to the RWSP is smaller than the driving head; therefore, the spray water would not overflow from the container, even though a conservative maximum flow rate is assumed.

d. The height of NaTB basket is 3' -11", as shown in RAI Figure 6.3.88-3, not 4' -11" as shown in DCD Figure 6.3-11. DCD Figure 6.3-11 will be revised to include the correct value as shown below.

As shown in RAI Figure 6.3.88-4, the transfer piping exits from the bottom of the container and rises to the horizontal portion of the U-pipe. The bottom of the U-pipe is located [ ] inches higher than the top of the basket, the U-pipe is 8.625 inches in diameter, and the top of the U-pipe is approximately 4 inches below the top of the basket container. As shown in RAI Figure 6.3.88-4, the spray water flowing into the container need to overflow the bottom of the U-pipe to be transferred to the RWSP. Therefore, the water level in the container is maintained at a level 4 inches higher than the top of the basket even though the minimum flow conditions for the containment spray ring D, and the baskets are completely submerged in the spray water.

Reference

6.3.88-1 CRANE Technical Paper 410M, P. 3-4

RAI Table 6.3.88-1 Maximum Spray Flow Rate

[ ]

RAI Table 6.3.88-2 (1/3) Flow Rate and Piping Pressure Loss
(From A-Container to RWSP)

[ ]

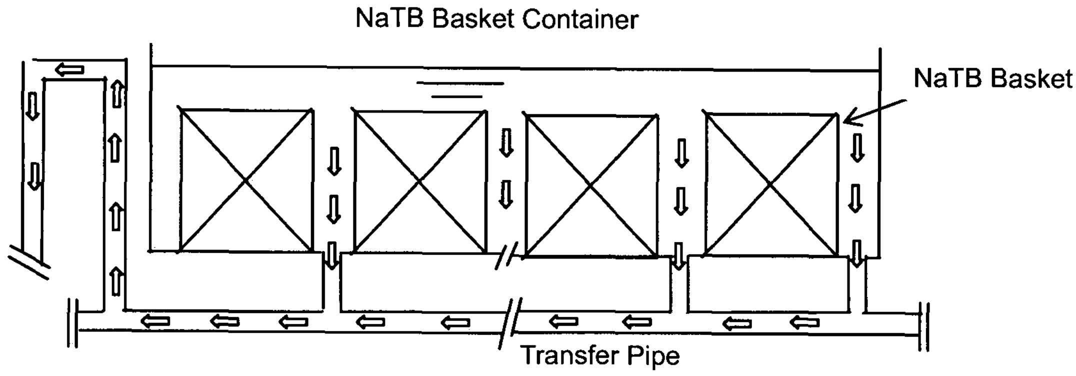
RAI Table 6.3.88-2 (2/3) Flow Rate and Piping Pressure Loss
(From B-Container to RWSP)

RAI Table 6.3.88-2 (3/3) Flow Rate and Piping Pressure Loss
(From C-Container to RWSP)

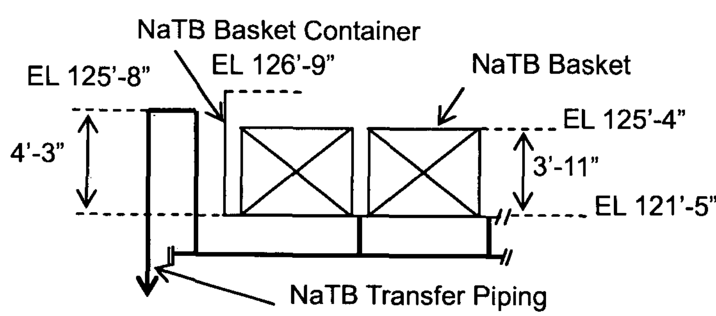
RAI Table 6.3.88-3 Comparison of Head Loss and Driving Head

[ ]

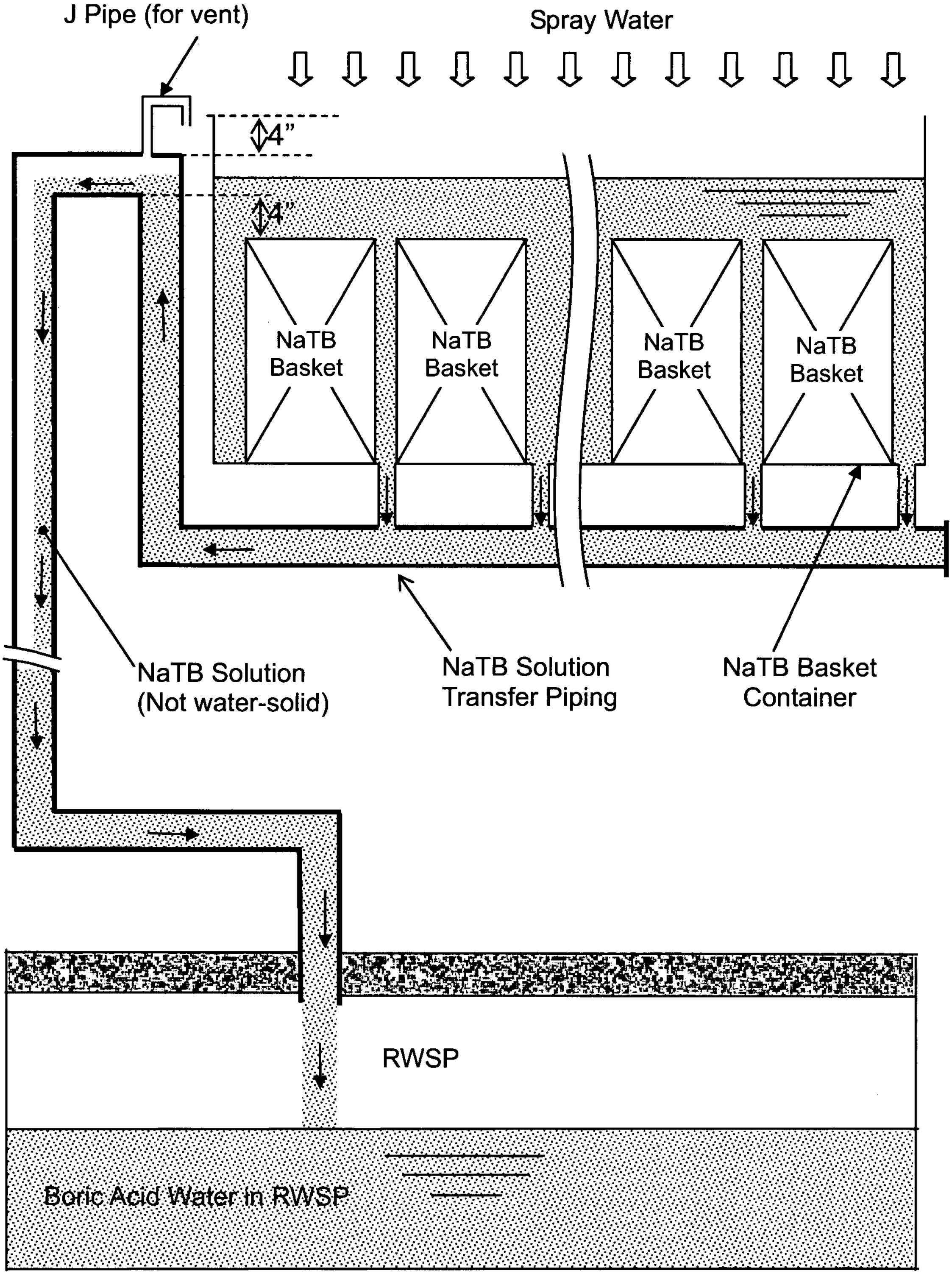
RAI Figure 6.3.88-1   NaTB Solution Transfer Piping Diagram



RAI Figure 6.3.88-2 NaTB Solution Flow Path



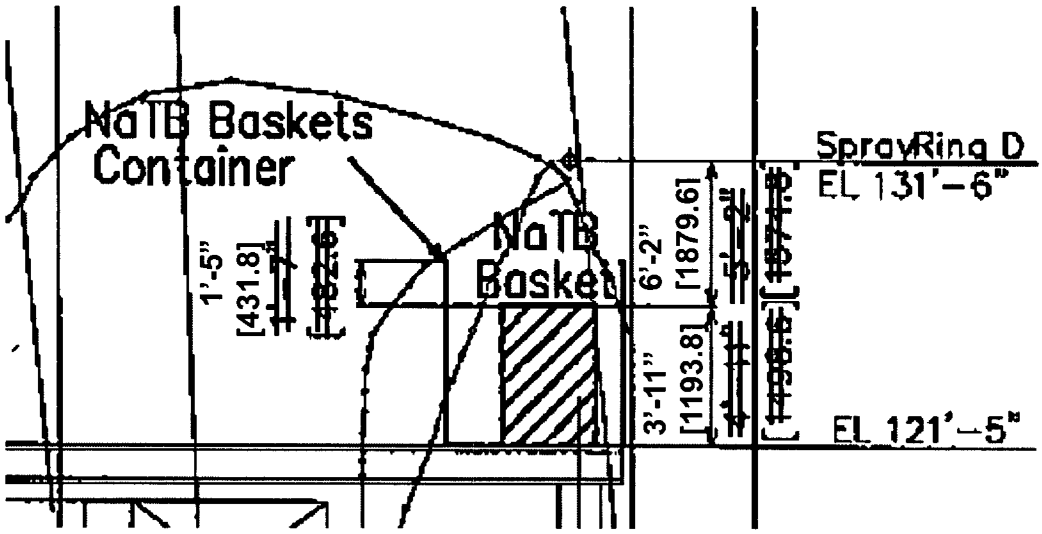
RAI Figure 6.3.88-3 Elevations around NaTB Basket



RAI Figure 6.3.88-4 NaTB Solution Flow during an Accident

Impact on DCD

Distances written in DCD Figure 6.3-11 will be corrected as shown below:



Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the R-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical / Topical Reports

There is no impact on the Technical / Topical Reports.